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TWO-STEPS MIXED PENSION SYSTEM: THE CASE OF THE REPRESENTATIVE INDIVIDUAL WITHIN A SOCIAL SECURITY NOTIONAL DEFINED CONTRIBUTION FRAMEWORK

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1. How to cope with ageing

RISK OF THE PAY AS YOU GO SYSTEM

- Fertility rate far below the replacement level
- Increasing life expectancy
- Unemployment

A person of 65 years

is really an old person ?????

Equivalent age today to 65 in 1900 (*)				
	Age at wich 26.2% of a generation survives in...		Age at wich age expectancy is 9.1 years in...	
	1900	2015	1900	2015
Men	65 years old	89 years old	65 years old	79 years old
Women	65 years old	93 years old	65 years old	82 years old
All	65 years old	91 years old	65 years old	81 years old

(*) In 1900, at 65 years old, a 26.2% of a generation survived in Spain and remaining life was 9.1 years (unisex)
Fuente: own computations from data from INE

ONE FIRST SOLUTION: COMPLEMENTARY SYSTEM !!!!!!

BUT

ANNUITIES

- Mitchell et al. (1999) show that lifetime annuities in the United States are between 15% and 25% lower than those obtained when using overall population life tables.
- Finkelstein and Poterba (2000) also show that lifetime annuities in the UK, which are taken out by 65-year-old men, are between 10% and 15% lower than those that would be obtained using ordinary overall population life tables.
- Domínguez-Fabian, (2017) find that in Spain annuities may be also around 29% lower than those obtained using ordinary life tables

1. How to cope with ageing

Overloaded annuities: The Spanish case

Table 1. The impact of longevity risk on annuities (term versus life) using Spanish Mortality Tables

Hypothesis of analysis		
Starting age of contributions (with continuous contributions during the entire working life)	30	
Retirement age	67	
Grand age (a)	78	
Salary at the starting age of contributions	20,000 €	
Interest rate	3%	
Annual increase in wages	3%	
Expected inflation	2%	
Results	**Term annuity (b)**	**Life annuity (c)**
Annuity computed using PERM/F 2000 Table	33,593.76 €	14,359.05 €
Annuity computed using the ordinary Mortality Table	35,289.29 €	20,299.95 €
Annuity value gap due to compensation for longevity	-4.80%	-29.27%

Notes:

(a) Age at which the Social Security initiates the payment of pensions in the two-steps mixed system (see below)
(b) Term annuity individuals obtain between the retirement age and the grand age, when the SS grants their life annuities
(c) Life annuity at retirement age

Source: Compiled from Herce and del Olmo (2013)

Source: Domínguez-Fabián, (2017)

- **The problem that occurs in the case of lifetime annuities (because of adverse selection and over-weighted mortality) is significantly reduced in the case of temporary annuities (even if still present)**

1. How to cope with ageing

PROBLEMS

1. The Contributors do not want to retire later.

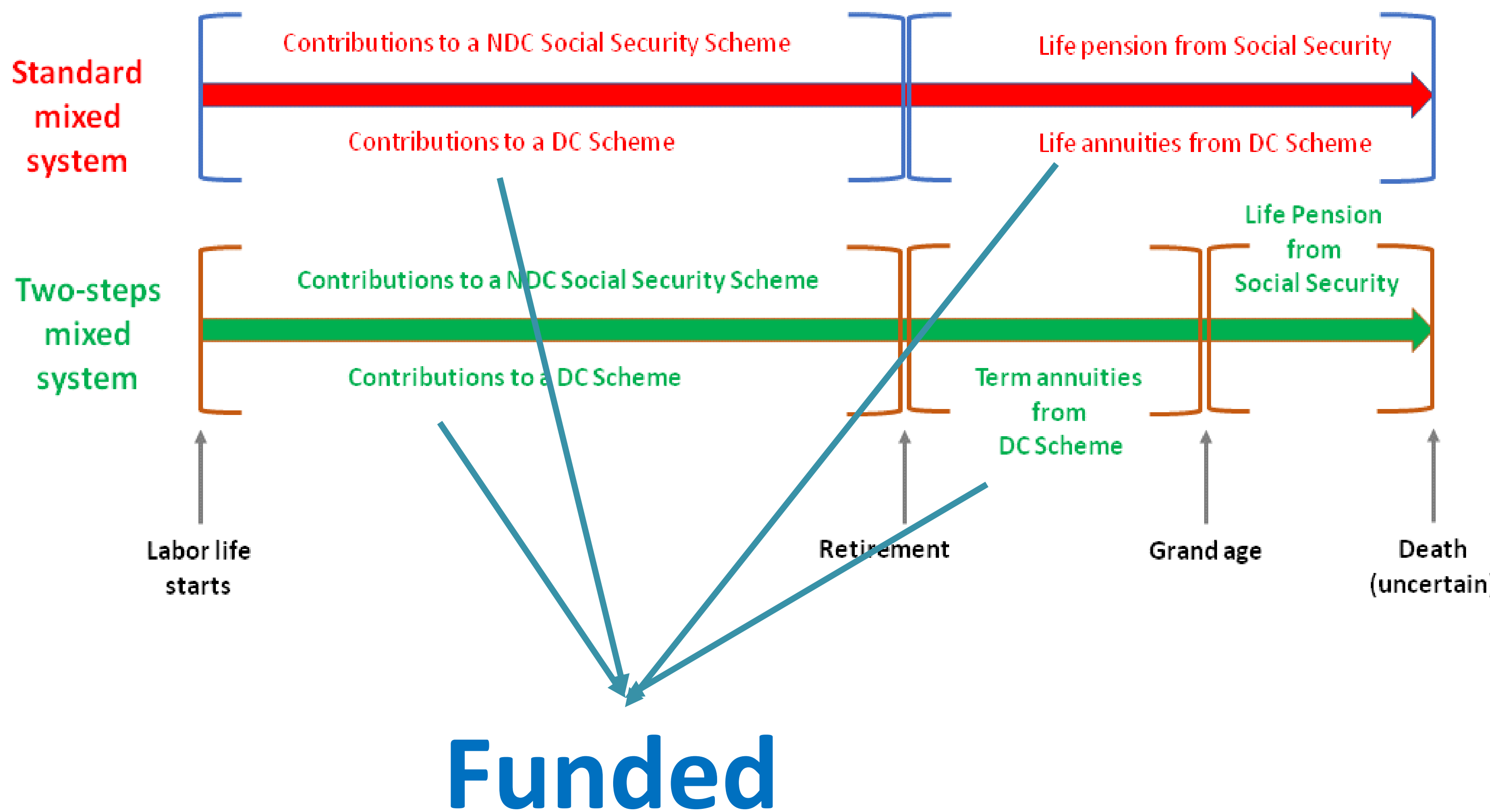
2. The Contributors obtain a low return from their contributions to the private saving with the annuity.

3. The Social Security has problem to pay the same pensions during more time.
4. The Social Security has problem because people do not want to retire later.
5. The Social Security has problem with the balance: deficit

http://celebracnc.com/2017/08/28/el-poder-para-solucionar-problemas/

6. The insurers have problems because a lot of people “decide” not to save in social prevision

2. A Two-steps Mixed Pension System



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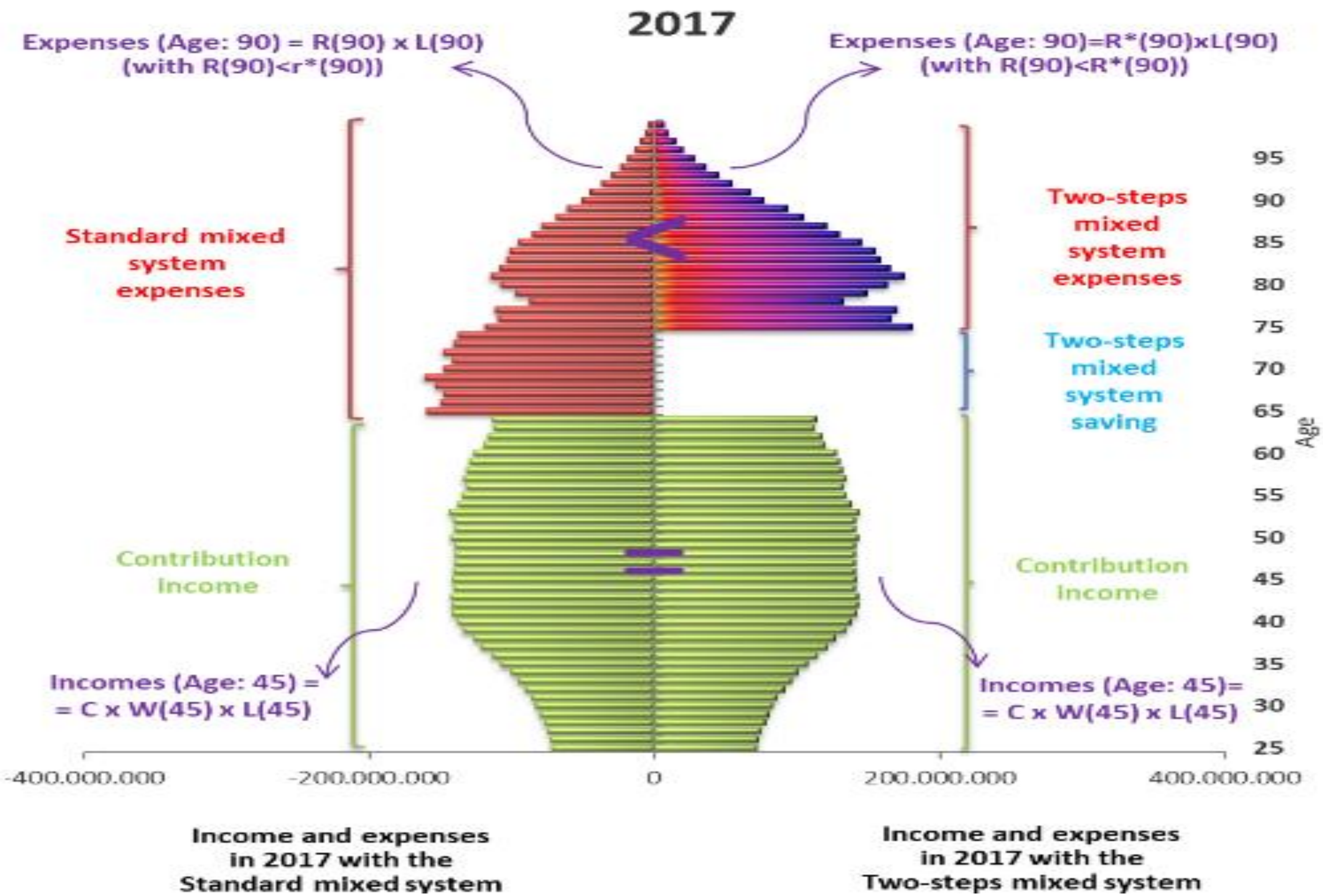

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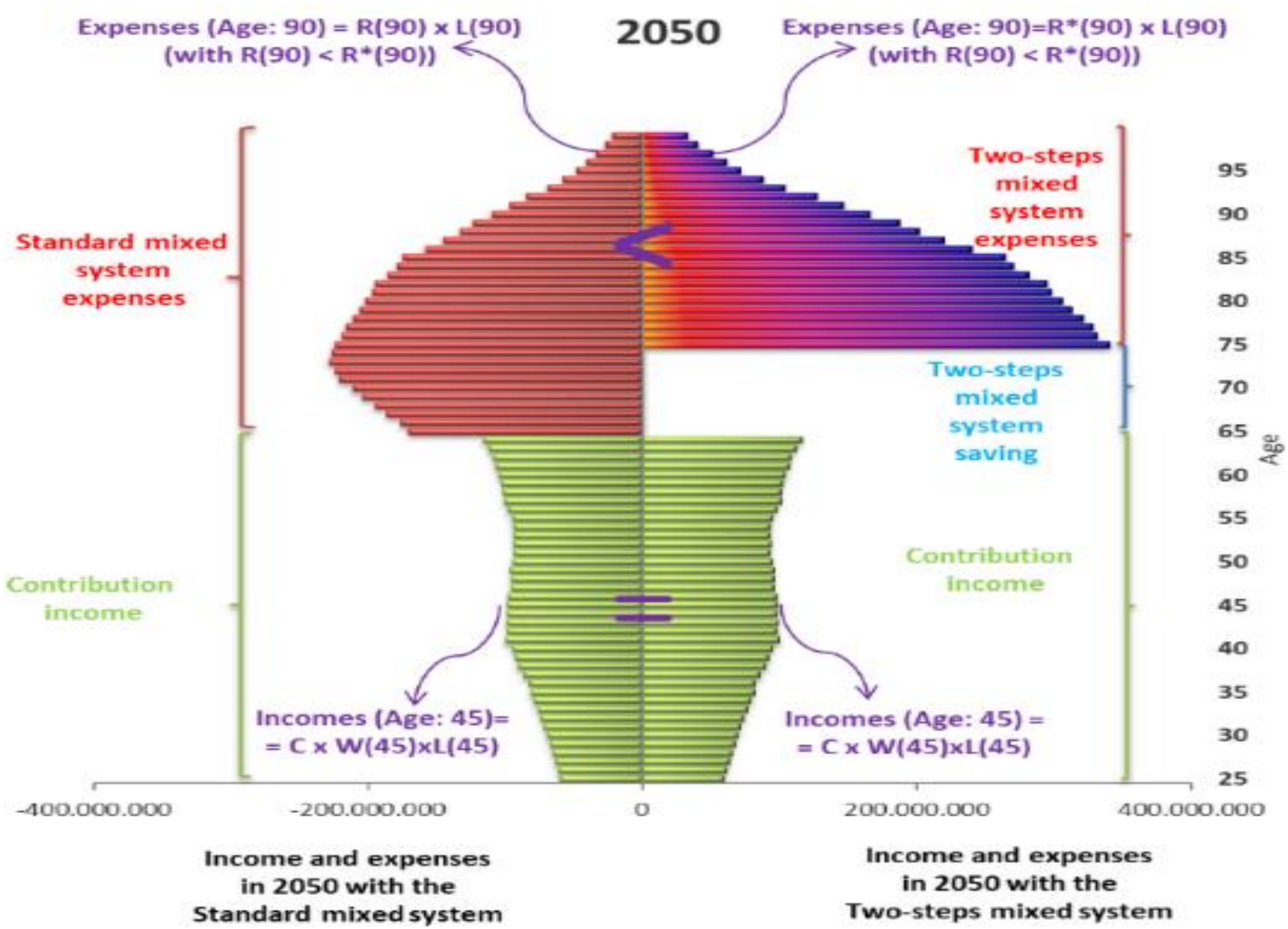


Modelling

Assumptions :

Social Security system in DC with a part in ***PAYG*** (NDC) and a part in ***funding***

$$\pi_N = \text{fixed contribution rate in NDC}$$
$$\pi_F = \text{fixed contribution rate in funding}$$

Accumulation period between age x_0 and age x_r ($N = x_r - x_0$)

Decumulation period between age x_r and age w

Comparison between the standard model and the 2-steps system from an ***individual*** point of view (*level of the benefits through the IRR*) and an ***aggregated*** point of view (*balance sheet of the social security PAYG system*)

Accumulation period in funding

- Funded account at retirement age (financial computation without mortality) :

$$C_F = \pi_F.(\sum_{j=0}^{x_r-1-x_0} (S(0)(1+\beta)^j(1+k)^j).(1+i)^{N-j)})$$

Initial wage — Inflation — Scale — Financial return

$$C_F = \pi_F.S(0).(1+i).\frac{(1+i)^N-(1+\beta)^N.(1+k)^N}{(1+i)-(1+\beta).(1+k)}$$

It is the same form with the two models!

2. A Two-steps Mixed Pension System

Accumulation period in NDC

- Notional account at retirement age (notional computation without mortality) :

$$C_N = \pi_N.(\sum_{j=0}^{x_r-1-x_0} (S(0)(1+\beta)^j(1+k)^j).(1+r)^{N-j)})$$

Initial wage   Inflation   Scale   Notional rate

Canonical choice : $1+r=(1+\beta).(1+d)$

Demographic increase

$$C_N = \pi_N.S(0).(1+r).\frac{(1+r)^N-(1+\beta)^N.(1+k)^N}{(1+r)-(1+\beta).(1+k)}$$

It is the same form with the two models!

Decumulation period in the standard model *Funded part*

Conversion of the funded capital into a ***life annuity*** using an insurer tariff (safety margin on the survival probabilities ; management costs)

$P_F(x_r) =$ initial pension at retirement age for the funded part

$$P_F(x_r) = \frac{C_F}{a_{x_r}{}^F}$$

$$a_{x_r}{}^F = \frac{1}{1-g}.\left(\sum_{x=x_r}^{\omega} {}_{x-x_r}\overline{p}_{x_r}.(1+\beta)^{x-x_r} / (1+i)^{x-x_r}\right)$$

Management cost

Insurer life table for lifetime annuity

Decumulation period in the standard model *NDC part*

Conversion of the notional account into a ***life annuity***

$$P_N(x_r) = \text{initial pension at retirement age for the notional part}$$

$$P_N(x_r) = \frac{C_N}{a_{x_r}{}^N}$$

$$a_{x_r}{}^N = \left(\sum_{x=x_r}^{\omega} {}_{x-x_r}p_{x_r} . (1+\beta)^{x-x_r} / (1+r)^{x-x_r}\right)$$

Population life table

Decumulation period in the standard model

Total

Pension at age x : $x_r \leq x < \omega$

$$P(x) = P_F(x_r).(1+\beta)^{x-x_r} + P_N(x_r).(1+\beta)^{x-x_r}$$

Funded Part

Notional Part

Decumulation period in the 2-steps model

Funded part

Conversion of the funded capital into a ***term annuity*** using an insurer tariff (safety margin on the survival probabilities ; management costs) between retirement age xr and great age y

$$P_F(x_r) = \text{initial pension at retirement age for the funded part}$$

$$P_F(x_r) = \frac{C_F}{a_{x_r,y-x_r}{}^F}$$

$$a_{x_r,y-x_r}{}^F = \frac{1}{1-g}.\left(\sum_{x=x_r}^{y-1} {}_{x-x_r}p^{\%}_{x_r}.(1+\beta)^{x-x_r}/(1+i)^{x-x_r}\right)$$

Management cost

Insurer life table for temporary annuity $\neq$ Insurer life table for lifetime annuity

NDC part

Decumulation period in the 2-steps model

Conversion of the notional account into a ***life annuity*** starting at the great age y (***deferred annuity***)

$P_N(y) = \text{initial pension at great age for the notional part}$

$$P_N(y) = C_N \cdot \frac{(1+r)^{y-x_r} \cdot (1-\delta) / {}_{y-x_r}p_{x_r}}{a_y^{\ N}}$$

Price of deferred annuity

Eventual loading

$$a_y^{\ N} = \left(\sum_{x=x_r}^{\omega} {}_{x-x_r}p_{x_r} \cdot (1+\beta)^{x-x_r} / (1+r)^{x-x_r} \right)$$

Population life table

Decumulation period in the 2-steps model

Total

Pension at age x :

$$x_r \leq x < y$$

$$P(x) = P_F(x_r).(1+\beta)^{x-x_r}$$

Funded Part

FIRST STEP

$$y \leq x < \omega$$

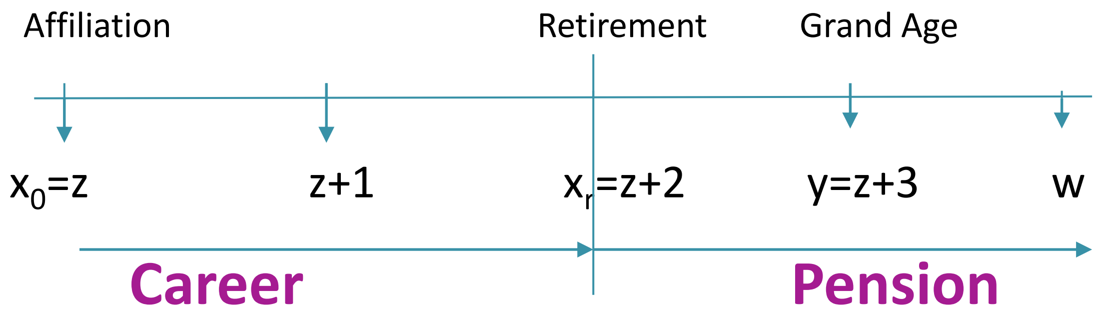
$$P(x) = P_N(y).(1+\beta)^{x-y}$$

Notional Part

SECOND STEP

3. Individual perspective: IRR

Model over 4 periods of time



Hypothesis		
FUNDING	Contribution rate	0.04
	Funding rate	0.04
	Management cost	0.0125
NDC	Contribution rate	0.16
	Notional rate	0.04
Inflation	0.02	
Probability	0.95	
Scale	0.01	

Standard Model

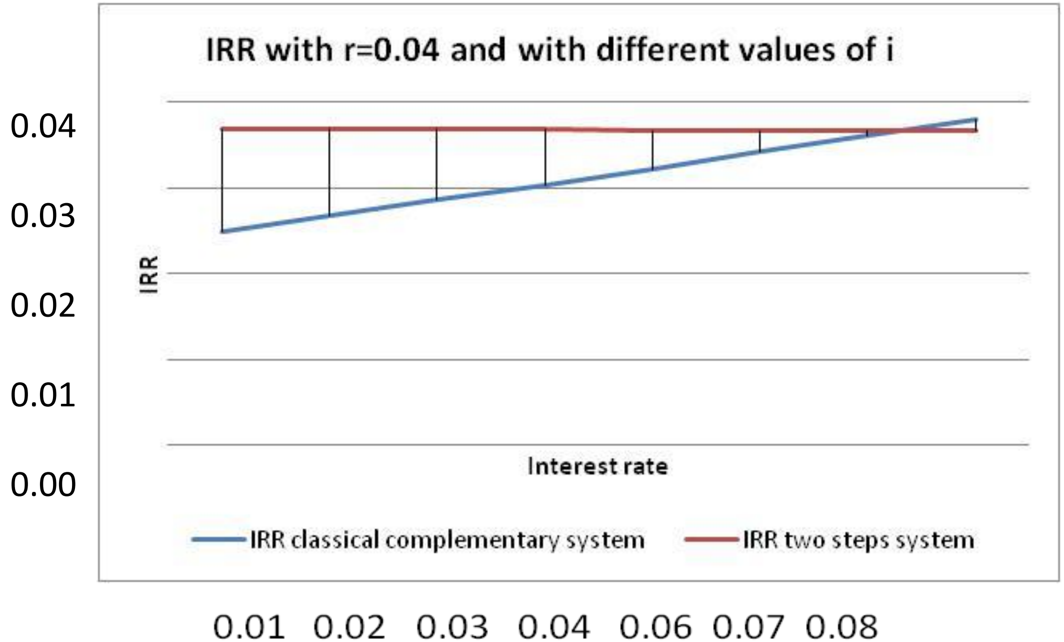
IRR= 0.03038558

2-steps Model

IRR= 0.03157632

3. Individual perspective: IRR

Case 1. Without commission in funding and using the same life table in notional and in funding and with the interest rate i different from the notional rate r.



Case 2. It is interesting to work with the realistic case with commission in funding and using the different life table in notional and in funding and with the interest rate i different from the notional rate r.

4. Aggregate perspective: balance sheet

Model over 4 periods of time / NDC part

POPULATION					
		TIME			
		0	1	2	3
AGE	Z	100,000	101,960	103,958	105,996
	Z+1	98,078	100,000	101,960	103,958
	Z+2	96,192	98,078	100,000	101,960
	Z+3	89,626	91,383	93,174	95,000

INDIVIDUAL WAGE					
		TIME			
		0	1	2	3
AGE	Z	100	102	104.04	106.12
	Z+1	101	103.02	105.08	107.18

4. Aggregate perspective: balance sheet

Model over 4 periods of time / NDC part

Classical model

BALANCE				
	TIME			
	0	1	2	3
Incomes	3,981,169.09	4,140,384.00	4,305,966.24	4,478,170.44
Outcomes	3,981,169.09	4,140,384.00	4,305,966.24	4,478,170.44
Balance	0	0	0	0

Two steps model

BALANCE				
	TIME			
	0	1	2	3
Incomes	3,981,169.09	4,140,384.00	4,305,966.24	4,478,170.44
Outcomes	3,961,263.24	4,119,682.08	4,284,436.41	4,455,779.59
Balance	**19,905.85**	**20,701.92**	**21,529.83**	**22,390.85**

5. Concluding comments

Possible to calibrate the **2 steps** system to obtain added value for all the stakeholders

- Better IRR for the ***Contributors***
- Better balance for the ***social security***
- Better design of product for ***insurers***

https://fr.dreamstime.com/images-libres-de-droits-r%C3%A9solution-des-probl%C3%A8mes-image38483749

Thank you

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